



ORIGINAL RESEARCH ARTICLE

Effectiveness of Game Elements on Students' Learning with  
Behaviorism and Constructivism Approaches

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ABSTRACT

The current research aimed to investigate the effectiveness of gamification with behaviorism and constructivist approaches enriched with game elements appropriate to each approach. The statistical population of the present study includes all 5th-grade students of Karaj City Primary School who studied in the academic year 2023-2024. The research design used in this study was Solomon's four-group quasi-experimental design, using control groups and conducting pre-tests and post-tests for the required groups. The sampling of the current research was based on available sampling and random selection of samples in groups. After the implementation of designed educational games (one group enriched with elements such as points, badges, and scoreboard and another group enriched with elements of feedback, group discussion, and cooperation) in 6 training sessions, the collected data were analyzed by two-way ANOVA and Scheffe's post hoc test. The research data were obtained by using a teacher-made learning test on the taught content. The results of the analysis showed that both games with constructivist and behaviorist approaches and categories of game elements used in groups had sufficient effectiveness. However, in the group trained with the game designed with a constructivist approach and enriched with elements of feedback (integrated with cooperation, and group discussion for constructivism approach) more learning happened than in the other group. ©authors

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## 1. Introduction

In an era where education is important for societal advancement, governments, institutions, and researchers worldwide invest substantial resources to enhance learning opportunities for children and adolescents (Barett et al., 2019). The quest for effective educational practices has led to extensive research on various factors influencing learning quality (Hanus & Fox, 2015). Among influential factors that were recognized, motivation and engagement have emerged as critical determinants of student success, shaping academic achievement and lifelong learning habits (Collie & Martin, 2019). Among these influential factors, motivation and engagement have emerged as critical determinants of student success, significantly shaping academic achievement and fostering lifelong learning habits (Collie & Martin, 2019). Research has demonstrated that motivation not only directly impacts learning outcomes but also enhances students' academic performance (Ee how et al., 2024). Furthermore, engagement plays an equally vital role in student success and overall learning experiences (Sun & Zhang, 2024). So educators pay attention to finding a way to bolster these factors' effectiveness such as motivation, engagement, satisfaction, effort, and... which can strongly help to create a better learning outcome (Hanus & Fox, 2015).

### 1.1 Gamification

As previous research findings show, one of the ways to improve learning factors' effectiveness is gamification (Kapp et al., 2014, p. 35). Gamification was introduced in the last decade, finding applications across various fields, particularly in education (Kalogiannakis et al., 2021). In response to challenges such as students' engagement, and motivation within educational environments, recent research has increasingly employed gamification strategies and activities to address these issues (Olivia et al., 2023). The scientific literature presents various definitions of gamification; however, the most widely accepted definition describes it as the incorporation of game design elements into non-game contexts (Manzano-León et al., 2021). Granter defines gamification as the integration of game elements—such as mechanisms, dynamics, and factors—into non-game contexts, including fields like medicine, health, staff performance, business, and notably, education (Christopoulos & Mystakidis, 2023., Kapp, 2012, p. 10).

In education, gamification emerges as an impressive approach to creating engaging and effective learning environments (Olivia et al., 2023). To that end, Robert T. Hays' meta-analysis (2005) by examining 274 documents due to designing, implementing, and evaluating games in learning environments shows that gamified classes have more efficiency than traditional classrooms (Kapp, 2012, p. 80). Gamification has the potential to make learning not only more enjoyable but also significantly more engaging, leading to improved academic performance among learners (Kačerauskas et al., 2022). Additionally, it enhances students' perceptions of achievement and academic success while fostering key experiences such as challenge, flow, immersion, and intrinsic motivation (Khattib & Alt, 2024).

While a limited number of studies challenge the efficacy of educational games, the prevailing consensus supports the positive impact of game-based learning (GBL) (Hanus & Fox, 2015). It is crucial to note that successful GBL relies on well-designed educational games that incorporate authentic game elements. In essence, an effective educational game is characterized by a thoughtful integration of game design principles and educational content, ensuring that learning objectives are met while maintaining engagement (Mahdavinabasab, 2016).

### 1.2. Game elements

Therefore, standard and qualified serious games are formed with various game elements. According to Karl Kapp's opinion, game elements include the following: rules, time, feedback, points, avatar, level, storytelling, authenticity, and replay (2012, p. 26)

According to researchers' findings, most frameworks do not consider Storytelling and authenticity as essential game elements (Toda et al., 2019). But the other mentioned elements have attracted the attention of researchers and educators more than others (Manzano-León et al., 2021). To that end effectiveness of points, badges, and scoreboards has been verified through several researches (Cigdem et al., 2024; Koppitsch & Meyer., 2022; Leito et al., 2022; Sanmugam et al., 2016; Huang and Fun Hew, 2015; Mekler et al., 2013). Another game element that is at the center of researchers' attention is feedback. Feedback's effectiveness is proved by the conducted research (Ogino & Matsuguma, 2024; Jahn et al., 2021; Chu and Fowler, 2020; Ahmad, 2019; Matsumoto, 2016; Mazarakis, 2015; Kikmerrust, 2015; Astwood, 2008; Erhel & Jamet, 2013).

Despite various articles relevant to the effectiveness of elements, such as points, scoreboards, badges, and feedback, other elements were not noted in the researchers' project. That's because of their public or null essence. But while deciding to increase motivation, engagement, and lastly learning, strong knowledge of constituent elements of the game and their effectiveness is needed. Furthermore, although two categories of elements (including points, scoreboard, and badges) and feedback were well-investigated by the researchers, because of studying each category in an isolated field there is no reliable knowledge of which category is more effective and which one of the elements can guide game designer, educator, and even self-motivated learner to the defined target.

### *1.3 Instructional design*

It seems that designing two games that have been enriched by these two game element categories is a suitable solution for this ambiguous part of gamification knowledge for comparing their effectiveness. What's more, Kapp (2012, p. 82) believes that many game designers do not consider instructional design in their game products. However, it is undeniable that an appropriate educational game is integrated with game elements and game design. (Mahdavinassab, 2016). Every educator faces various instructional design approaches and theories. Constructivism and behaviorism are two notable approaches (Hatami, 2022, p. 58). The constructivist approach asserts the necessity of establishing optimal conditions for learners to effectively build their knowledge and confidently pursue self-directed learning goals (Fardanesh, 2013, p. 74). On the other hand, behaviorism design, emphasizes facilitating the transferring process of knowledge from the outside environment to the inside of the learner's mind (Hatami, 2022).

Therefore, the current study aims to design and implement two educational games enriched by game elements (points, scoreboard, and badges in one category) and (feedback in the second category) through integrating behaviorism and constructivism approaches. Thus, there are two contributions through current research findings: first, clarifying the effectiveness of serious game elements, which is still unclear in previous research. The second valuable contribution is defining the effectiveness of behaviorism and constructivism approaches in gamification on students' learning.

And finally, the following research questions will be answered:

1. What effect do the inclusion of constructivist game elements (points, badges, and Scoreboard) and behaviorism ones (feedback) have on the outcome of students' learning in GBL?
2. What is the difference between gamification based on the approach of behaviorism and constructivism?

## **2. Literature Review**

Various research exists about gamification's effectiveness on learning. While its effectiveness is clear to us, the author focuses on the research regarding the influential factors in an effective game we will discuss. The importance of game elements in games that have been applied in gamification has been proved (Ruzieva,2024; Zourepakis et al., 2023; Habibpur, 2024;

Sanmugam et al., 2016). So in some research, educators went beyond the game and utilized game elements in producing content which have been enriched by augmented reality (AR). As a result, the integration of AR and game elements strengthens the learning experience of learners (Ramli et al., 2024). In conclusion, if game elements are used correctly in the game environment, not only enhance academic performance but also cause a heightened motivation and eagerness to learn (Zourmpakis et al., 2023). Creativity, Social skills, and mental imagination improvement are the outcomes of sufficient game elements utilization in the game (Ruzieva, 2024).

But in the game elements case, only a few elements have been well-investigated by the researchers. Points, badges, and scoreboards are some of the most frequent elements. Research has shown that a game's effectiveness will increase if elements such as points, badges, and scoreboards are used in serious games. These research findings were obtained through a qualitative approach via interviews (Sanmugam et al., 2016) or through quantitative analysis by examining participants' responses using statistical methods (Zourmpakis et al., 2023; Leito et al., 2022; Huang & Few, 2015). Research in this field has not only examined the effectiveness of points, badges, and scoreboards (PBS) in education but has also explored their drawbacks. One of the Research has been conducted to answer the question of whether points, badges, or scoreboards have negative effects on motivation or not. Noted elements were examined in a gamification environment. Then, the result of the research showed that PBS has a positive effect on academic performance and has no effect on motivation and autonomy (Mekler et al., 2013). According to several mentioned research, PBS is effective in increasing students' learning and motivation.

These elements are quantitative in nature, and due to their application in behavioral approach games, have significantly impacted outcomes. But, the researchers were not limited to these three elements and have been focused on feedback as an influential element. Feedback, despite PBS, is qualitative and can be utilized in instructional designs through a constructivist approach. In essence which can be used in instructional designs by the constructivist approach. So, elements such as interactive problem-solving, goals, rules, adaptive challenges, control, and frequent feedback are core factors of well-designed games (Ahmad, 2019). As Matsumoto (2016) has noted in his article, assignments, sufficient user interface, and feedback are some of the factors of well-designed games.

In this context, can refer to Kichmeire-Rust's research (2014). He discovered the positive impact of formative feedback in gamified classes by analyzing learning analytics data from Australian students' classrooms. Research has shown that feedback in educational games significantly enhances learning outcomes, academic performance, engagement, and motivation (Matsomoto, 2016). To that end, Masarakis (2015) In that end, Mazarakis (2015) presented the outcomes of six studies showing that feedback in gamification led to increased student engagement in all cases. Also, embedding formative feedback in games can eliminate misunderstandings and increase motivation and engagement in learning (Chew & Fowler, 2020). If learners receive appropriate feedback during the game, their performance will improve, leading to deeper learning (Erhel & Jamet, 2013).

According to Carl Kapp (2012), an educational game can be more effective when it incorporates the correct and suitable instructional design (ID). Using principles of ID in game design enhances its effectiveness (Mahdaviniasab, 2016). Although game elements are various, but The significant elements in students' learning that are interesting to researchers are limited in scope. Points, badges, and scoreboards can be introduced as quantitative elements suitable for applying behavioral approaches, while feedback can be used as qualitative elements in a constructivism-based game. In noted studies, the effectiveness of both categories of elements (PBS and feedback) was investigated.

There appears to be a research gap regarding examining two categories of elements, which have different quantitative and qualitative natures. Additionally, the distinct approaches of behaviorism and constructivism concerning each other have not been sufficiently analyzed.

This lack of examination creates ambiguity about which approach is more beneficial for educational game designers. Addressing this gap could help designers achieve their primary goal of facilitating effective student learning.

### 3. Method

#### 3.1 Research questions and hypothesis

Two main sets of questions were asked at the beginning of the study:

First, what effect do the inclusion of constructivist game elements (points, badges, and Scoreboard) and behaviorism ones (feedback) have on the outcome of students' learning in GBL?

Second, what is the difference between gamification based on the approach of behaviorism and constructivism?

Regarding the hypothesis, initially, two main results were predicted. First, both constructivism and behaviorism game elements (PBS and Feedback) have positive effects on students' learning. And then, GBL course which is powered by a constructivism game is more effective than the behaviorism one. The research questions will be answered through the study and the hypotheses will be tested.

#### 3.2 Research design

The research design of the current study is quasi-experimental and quantitative approach. Participants in this study were selected through an available sampling method (because of the large population and security of ministry of Education for achieving the school's population). So the researcher selected the workplace students as the general sample and the by the random sampling chose students and then randomly assigned them to control and experimental groups. The researcher used Solomon's four-group experimental design to eliminate the effect of the pre-test and preserve the external validity of the study. One of the interventions for the two experimental groups was the constructivism game, which that group included both a pre-test and a post-test. The control group also had a pre-test and a post-test but without any intervention. The second experimental group had a behaviorism game (as an intervention) and a post-test without any pre-test. In the control group, without the pre-test or intervention, the group was only assessed by the post-test.

**Table 1.** The Solomon four-group design for the study

group	Pre-test	Treatment	Post-test
Re1	T1	X	T2
Rc2	T1	---	T2
Re3	---	X	T2
Rc4	---	---	T2

#### 3.3 Participants

Due to the existing conditions, the Sampling method was available and the students of three classes of 5<sup>th</sup> grade elementary school (Imam Hadi school which is located in Khorram-dasht of Karaj city). The researcher categorized the students from the three classes into four groups (including two experimental and two control groups as explained above) with the cooperation of the teachers, using a random assignment method. Initially, all four groups consisted of a total of 29 students. The current research initially involved 29 female fifth-grade students. The students were in the same level of motivation, and socioeconomic status Due to the teachers' adequate understanding of their students. Also, students' portfolios helped the researcher to be sure about their equality of prior knowledge about life skills and having no previous experience of gamification in education. However, because the interventions consisted of 6 training sessions, each lasting 45 minutes, the study experienced a drop in participants (as it was predicted and this is so common for large numbers of samples in many of the research). The information of groups, participants, and their attrition reasons is shown in Table 1.

Ultimately, two groups had 28 participants, one group had 27, and the fourth group had 29 participants. The missed students were not considered in the data analysis to reduce bias and the following chart was reported only for increasing the trustworthiness of the research.

**Table 2.** Information of participants in the research

Groups	Initial participants	Type of the group	Pre-test	Intervention	Post-test	Participants attrition	The cause of attrition
G1	29	Behaviorism control	-	-	28	1	Absence
G2	29	Behaviorism experimental	-	Behaviorism game (PBS elements)	27	2	Migration to Afghanistan
G3	29	Constructivism control	29	-	28	1	Illness
G4	29	Constructivism experimental	29	Constructivism game (feedback element)	29	-	-

### 3.4 Procedures

The researcher had conducted 4 educational sessions to play a game, which was not the intervention of the study. These sessions aimed to reduce the novelty effect in research and then students' passion and excitement of using new technology in the teaching process did not impact the study. After training via the different game, students had a week to rest and then, the main course (which included research games) got started. In May 2024, the researcher began conducting training sessions for four designated groups. One session before the research implementation, a pre-test was administered to two groups (both the experimental and control groups of the constructivist game). After the research implementation was completed, a post-test was conducted for all four participant groups. In fact, there was a gap of approximately two weeks between the pre-test and the post-test. Training sessions were conducted on even-numbered days of the week, and research implementation sessions (45 minutes) took place during two training weeks. The researcher taught and conducted educational sessions to reduce the Rosenthal effect and the bias of the presence of different teachers (such as their attitude to gamification, underestimating the research, etc.).

The researcher focused on interventions during the study and could not teach her class, so she enlisted help from other teachers. As a thank-you gesture, he gave them a gift for their assistance.

### 3.5 Research tools and data collection

Two educational games, enhanced with various game elements, were utilized in control and experimental groups. One game incorporated points, badger, and scoreboards, following George Grouper's educational design approach. The other game focused on providing feedback, based on Janasen's educational design approach. Both games were produced and implemented in their respective groups. Both games were designed and developed by Adobe Photoshop, Articulate Storyline, and Camtasia software. The current research utilized a researcher-developed questionnaire containing 20 multiple-choice questions with four options each. This test was administered to students as both a pre-test and a post-test within the framework of Solomon's four-group design. The tests conducted were based on the first chapter of the fifth-grade social science curriculum, which was taught to the students through designed games. The questionnaire used in the test consisted of 21 questions. The first question was designed to help students become familiar with the question format. But, this initial question did not significantly contribute to data analysis or impact the research outcomes.

Because the test was teacher-made, both validity and reliability were accurately checked. For the validity of the test the test was sent to some of the EduTech experts and the confirmed relevance, clarity, and comprehensibility of the questions. Additionally, they evaluate whether the questions are appropriate for the current research and whether they can be effectively measured. To assess the reliability of the designed questionnaire, it was administered to 50 fifth-grade students who were not involved in the original research. The responses were

analyzed using SPSS statistical software, and the reliability was determined with a Cronbach's alpha coefficient of 0.81. As a result, its reliability is confirmed because it was more than 0.7.



Figure 1. Different scenes of the game (entrance page, leveling and games)

#### 4. Findings

Finally, the collected data were analyzed by SPSS software24 in both descriptive and inferential statistics. Inferential statistics include two-way ANOVA and a post-hoc Scheffe test to compare both groups. The result of descriptive analysis is presented in Table 2.

**Table 3. Descriptive statistics**

Status		N	Mean	Standard Deviation	Standard error	95% confidence level	
						Lower Bound	Upper Bound
Learning pre-test	Constructivism Experimental group	27	9.3704	2.22137	0.42750	8.4916	10.2491
	Behaviorism Experimental group	27					
	Constructivism control group	27	7.6296	2.76166	0.53148	6.5372	8.7221
	Behaviorism control group	27					
Learning post-test	Constructivism Experimental group	27	12.3704	2/25573	0.43412	11.4780	13.2627
	Behaviorism Experimental group	27	9.8519	2.36487	0.45512	8.9163	10.7874
	Constructivism control group	27	7.8889	2.40725	0.46328	6.9366	8.8412
	Behaviorism control group	27	8.8519	2.10683	0.40546	8.0184	9.6853

In Table 2 the values of descriptive statistics and central indicators such as mean, and standard deviation are reported. As can be seen, there is an increase in the learning variable between the pre-test and post-test for both the constructivism test group and the control group. In other words, the learning variable score for the constructivism experimental group improved in the post-test, while there was no change in the pre-test and post-test scores for the constructivism control group. To understand the differences in the scores obtained by the behavioral group, this paper will refer to the inferential analysis provided later. In the field of statistics, it's essential to examine the statistical distribution of data before conducting any inferential calculations. If the data follows a normal distribution, parametric statistical methods can be applied; if not, non-parametric methods should be used instead. To determine the normality of the data from both the experimental and control groups, the skewness and kurtosis of the data have been assessed.

**Table 4. Normality test**

Status	N	Skewness		Kurtosis	
	Statics	Statics	Standard Error	Statics	Standard Error
Learning pre-test	54	-0.184	0.325	-0.214	0.639
Learning post-test	108	-0.262	0.233	0.901	0.461

Since the quotient of skewness and kurtosis to the standard deviation falls between -2 to +2, we conclude that the score distribution at both stages is normal, meaning this assumption has been satisfied. No missing data was found in the research data review. Outliers are data points that are significantly larger or smaller than the other observations in a dataset. Since an outlier is removed from the body of the dataset, its validity is questionable. Therefore, it is essential to verify outliers' data to ensure they are not caused by errors in recording data. Outliers can also indicate unusual observations that should be investigated. So it was observed that after checking the outlier data, no outliers were found in the box plot. Additionally, no missing data was identified. Levene's test was employed to assess the homoscedasticity between the pre-test and post-test data. The null hypothesis of this test states that the data exhibit homoscedasticity in variance.

**Table 5. Leven's test**

	Status	Levene's Statistic	Df1	Df2	Sig
Learning	Based on Mean	1.217	3	104	0.307
	Based on Median	1.240	3	104	0.299
	Based on Adjusted Median and Degrees of Freedom	1.240	3	101.397	0.299
	Based on Trimmed Mean	1.433	3	104	0.237

Since the probability value of the test (sig) is greater than 0.05, this hypothesis is confirmed, indicating that the assumption has been met. In the following, the analysis of variance test was used for the significance of the tests. The table below presents the results of the analysis of variance. To determine the significance of each test, focus on the Sig value, which indicates significance if it is less than 0.05.

Table 6. ANOVA test

	Status	Sum of Squares	Df	Mean Square	f	sig
Learning	Between Groups	300.963	3	100.321	19.187	0.000
	Within Groups	543.778	104	5.229		
	total	844.741	107			

According to the significance level among the groups, there is a significant difference in the learning variable scores. However, to analyze these differences further, we need to conduct post hoc tests. In this case, we will use Scheffé's post hoc test.

Table 7. Scheffé's post hoc test

Dependent Variable	(I) Research Groups	(J) Comparison Groups	Mean Difference (I-J)	Standard Error	Significance	95% Confidence	
						Lower Bound	Upper Bound
Learning	Constructivist Experimental Group	Behaviorist experimental group	2.51852*	0.62234	0.002	0.7499	4.2871
		Constructivist control group	4.48148*	0.62234	0.000	2.7129	6.2501
		Behaviorism control group	3.51852*	0.62234	0.000	1.7499	5.2871
	Behaviorism experimental group	Constructivism experimental group	-2.51852*	0.62234	0.002	-4.2871	-0.7499
		Constructivism control group	1.96296*	0.62234	0.023	0.1944	3.7315
		Behaviorism control group	1.00000	0.62234	0.464	-0.7686	2.7686
	Constructivism control group	Constructivism experimental group	-4.48148*	0.62234	0.000	-6.2501	-2.7129
		Behaviorism experimental group	-1.96296*	0.62234	0.023	-3.7315	-1.944
		Behaviorism control group	-0.96296	0.62234	0.498	-2.7315	0.8056
	Behaviorism control group	Constructivism experimental group	-3.51852*	0.62234	0.000	-5.2871	-1.7499
		behaviorism experimental group	-1.00000	0.62234	0.464	-2.7686	0.7686
		Constructivism control group	0.96296	0.62234	0.498	-0.8056	2.7315

The above table shows the results of the post hoc test to determine the differences between groups in the average learning score. There is a significant difference between the effectiveness of constructivist and behavioral interventions. The mean difference between the two groups is significant ( $P < 0.05$ ). Therefore, there is a significant difference between the two interventions in improving learning scores. As the results show, the constructivist intervention proved to be more effective.

### 5. Discussion

Nowadays, technology has become integrated into many aspects of our lives. That's predictable that many works are managed electronically. The integration of technology and daily work can be seen in different fields. Such as medicine, communication, industry, and also engineering science. So, it is obvious that education has been affected by technology such as the mentioned fields. In recent years, technology has been utilized for achieving educational goals through various forms. Some of which have gained more popularity among learners and teachers. It is clear to us, that gamification has a significant effect on education. Robert Hays's meta-analysis (concluding 274 research) is one of the documents that confirm the noted sentence (2005). But, when educators can have an influential game, to have a well-designed game. And this would happen just by integrating suitable game elements with appropriate instructional design (Mahdaviniasab, 2016). Gamification has become one of the most popular methods of education, effectively integrating technology into the learning process (Olivia et al., 2023). While numerous studies have been published in the field of gamification, only a few have concentrated on game elements.

In the present study, the researcher focused on designing two games that incorporate behaviorist and constructivist approaches, integrating appropriate game elements to assess the effectiveness of these approaches as well as the impact of various game elements. So, points, badges, and scoreboard (PBS) have been used in behaviorism game and constructivism game fed by feedback (and cooperation, and group discussion for helping the game in constructivism approach), (FCG) elements. After conducting the research in 6 sessions (almost 2 weeks) and analyzing the collected data, the results showed that despite the positive effect of both educational groups, which confirmed the first hypothesis about the resulting positive effect on both groups' learning, the constructivist approach by using game elements such as (FCG) is more effective than the opposite group (due to Scheffe's test). So, Fifth-grade students who are twelve years old and not yet capable of analyzing issues as adults may develop a better understanding of concepts through games that are enriched with supporting game elements (such as FCG).

Additionally, integrating cooperation and group discussions (facilitated by the teacher) and providing instant feedback can enhance students' engagement and motivation with the game and its processes. By increasing engagement and motivation in students, the average of students' learning increases too. Finally, We see a more effective output and more learning from students trained with a constructivist group enriched with its appropriate elements. This outcome confirms the second hypothesis, which claimed that GBL course powered by a constructivism game is more effective than the behaviorism one. Based on the current research result, the constructivist approach, which is more effective than other approaches in traditional classrooms, played an effective role in e-courses and game-based learning, too. Also, since most of the studies in gamification are focused on its efficacy and less attention is paid to the game elements, the present research has contributed to this deficiency.

The higher level of constructivism game's effectiveness can be related to the flexibility of the game's nature. Feedback has the potential capacity to explain items and fade misunderstandings among students by its flexible nature (Yang & Lu, 2021). Appropriate feedback embedded in the game caused increasing academic performance and the quality of learning (Freitas, 2023). And also, cause of the importance of constructing knowledge through students' experiences in the constructivist approach (Fardanesh, 2013, p 46) can be concluded that the knowledge which is made and processed by human creation is more stable and permanent than what is transmitted to the mind through various ways (Hatami, 2005). So, the game that is enriched with suitable feedback causes more engagement and fewer misunderstandings in students. That means Although both categories of game elements can have positive effect on learning outcomes, etc. only feedback can unravel the students' minds. In the author's opinion, an educational game can be beneficial due to using appropriate feedback.

## **6. Conclusion**

In conclusion, this research demonstrates that game-based learning is significantly more effective when prioritizing the quality of feedback elements over PBS elements. It can be concluded that a game achieves its maximum effectiveness when it incorporates both categories of elements; however, particular emphasis should be placed on the quality of embedded feedback and the nature of learner cooperation. There is now a clear understanding of the effectiveness of game elements, fostering optimism that future studies. The presented research can open a wide perspective for researchers who are interested in game elements and their efficacy. More studies are needed in the field of game elements, especially in feedback, its effects, and its potential capacities in GBL and e-courses. Also, since most of the research in the field of gamification has focused on the generalities of the matter and less attention has been paid to the components of educational games, which include game elements, the present study aims to compensate for this deficiency.

Some limitations exist in the current study that made the research pathway harder. The lack of digital devices in school and the shadow of poverty on students' families caused some issues in the way. Due to the lack of appropriate infrastructure to provide an educational game, including a chat box, to form better social interaction and communication, the researcher was forced to implement and manage this issue in real space. If utilizing chatbots were possible, first, the researcher's workload would be reduced, and then research results would be more accurate than the current situation. In the imagined situation, the games would be presented on mobile devices without any problem with the old computer systems. However, it had not effected the result of the research because of the appropriate alternative and the researcher's controlling on the situation of the research.

Due to the implemented research and its results, some practical suggestions are provided. First, for gaining better academic results it's better to implement GBL courses in HDMI formats which can be used in mobile devices instead of exe format. Second, enriching educational games with suitable learning feedback can make your game more effective and more scaffolded due to cognitive apprenticeship theory. Using scoreboard games and can make your game challenging for students.

The presented research can open a wide perspective for researchers who are interested in game elements and their efficacy. More studies are needed about the various types of feedback, specifically Knowledge Control Feedback (KCR), Emotional Feedback (EF), Outcome Feedback (OF), Formative Feedback (FF), and Corrective Feedback (CF) (Liu et al., 2021; Tsai et al., 2015). Future studies should explore the effects and potential capacities of these feedback types within Game-Based Learning (GBL) and e-learning environments. A comparative analysis of their effectiveness, along with a systematic categorization based on their influence and suitability for game contexts, is essential. Additionally, the integration of game elements with other educational methodologies presents a promising avenue for further research.

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### **Declaration of Competing Interest**

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